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IS : 1991 (Part 3) - 1987

Indian Standard

(Reaffirmed 2002)

SAFETY REQUIREMENTS FOR THE USE, CARE AND PROTECTION OF ABRASIVE GRINDING WHEELS

PART 3 GENERAL MACHINE REQUIREMENTS

(Second Revision)

1. Scope — This standard (Part 3) covers the general requirements of the machines used for grinding.

2. General Requirements

2.1 *Machine Design and Maintenance*

2.1.1 *Machine manufacturer's responsibility* — The machine manufacturer shall design and build the grinding machines in accordance with established standards to provide for the safe utilization of abrasive wheels in accordance with this standard.

Grinding is a safe operation under normal conditions. Severe stresses can be set up in the wheel if established, safe operating practices are not maintained. Only machines designed for the required spindle speed with suitable bearings to take the pressure and thrust of the grinding operation are recommended.

2.1.2 *User's responsibility* — The user shall maintain grinding machines in a manner that provides for safe operation in conformity with this standard.

To ensure the safe operation, proper maintenance of grinding machines by the qualified personnel is very important.

2.2 *Safety Guards* — Grinding machines shall be equipped with safety guards in conformity with the requirement, covered in IS : 1991 (Part 4)-1987 'Safety requirements for the use, care and protection of abrasive grinding wheels: Part 4 Safety guards'.

Safety Guards must be used on grinding machines to ensure protection in case of an accidental wheel breakage [for exceptions, *see* IS : 1991 (Part 4)-1987].

2.3 *Spindle*

2.3.1 *Diameter of spindle* — Minimum diameter of spindles which should be used for wheels of various sizes are shown in Table 1. It applies to the machines where grinding wheels are not mounted between the bearings. The use of heavier spindles than those given in Table 1 is often desirable.

Standard machine design generally conforms to the minimum spindle diameter requirements of Table 1. Investigation often shows that requests for undersize holes result from the use of larger diamater wheels than originally intended for the machine. Other factors including flange diameter, excessive speed and suitable safety guards, should be investigated before considering approval of wheels with holes smaller than those specified in Table 1.

2.3.2 *Size of spindle or mount* — Abrasive wheels shall fit freely on the spindle (wheel sleeves or adaptors) and remain free fitting under all grinding conditions. To accomplish this, the spindle or wheel mount shall be made to nominal (standard) size plus zero, minus 0·05 mm measured at 27°C.

Abrasives Sectional Committee, EDC 13; Grinding Wheels Subcommittee, EDC 13 : 1 [Ref : Doc : EDC 13 (4715)]

Adopted 15 December 1987

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

TABLE 1 MINIMUM DIAMETERS OF MACHINE SPINDLES AT POINT OF MOUNTING FOR OVERHUNG WHEELS OF VARIOUS DIAMETERS AND THICKNESS OPERATING AT SPEEDS UP TO 48 PERIPHERAL METRES PER SECOND

(*Clause* 2.3.1)

All dimensions in millimetres.

Diameter of Wheel	Thickness of Wheel												
	6	10	13	16	20	25	32	40	50	63	80	100	125
	Diameter of Spindle												
50	3	5	5	6	6	10	—	—	—	—	—	—	—
75	6	6	10	10	10	10	—	—	—	—	—	—	—
100 (101·6)	8	10	10	10	10	10	13	13	13	—	—	—	—
125 (127)	10	10	13	13	13	13	13	13	13	—	—	—	—
150 (152·4)	13	13	13	13	13	13	13	13	16	20	20	20	25
175 (177·8)	13	13	13	13	13	13	16	16	16	20	20	25	25
200 (203·2)	13	13	13	13	16	16	16	16	20	20	25	25	25
230	16	16	16	16	16	16	20	20	20	25	25	32	32
250 (254)	16	16	16	16	20	20	20	20	20	25	32	32	32
300	20	20	20	20	20	20	20	25	25	25	32	32	38
350	20	20	20	20	25	25	25	25	25	32	32	38	38
400	—	—	—	—	32	32	32	32	32	32	38	38	45
450	—	—	—	—	32	32	32	32	32	38	38	45	45
500	—	—	—	—	—	38	38	38	38	38	45	45	50
600	—	—	—	—	—	38	38	38	38	38	45	45	50
650	—	—	—	—	—	—	38	38	38	45	50	50	50
750	—	—	—	—	—	—	—	45	45	45	50	57	57
900	—	—	—	—	—	—	—	—	50	50	57	64	70
1 000	—	—	—	—	—	—	—	—	64	64	70	75	80
1 250	—	—	—	—	—	—	—	—	—	75	80	90	90

Note 1 — For speeds exceeding 48 m/s and for wheels with heavy mountings (such as bolted-up abrasive discs), the spindle *size* shown in Table 1 are usually not adequate. In as much as the proper spindle size is dependent upon many factors, such as general design of the machine type of bearings, quality of materials and workmanship, a simple table is not practicable. Wheels larger than specified by the machine manufacturer should not be used on any given machine.

Note 2 — Values in brackets are non-preferred.

To avoid rupturing pressure in the wheel hole, the diameter of spindle or wheel mount must be as specified so that there is clearance between the wheel hole and the spindle or wheel mount under all operating conditions. The wheel hole should be made suitably oversize to assure safety clearance under the conditions of normal operating heat and pressure.

Exception

On machines using wheels 250 mm or greater in thickness or equipped with 50 hp or greater driving power, the spindle or wheel mount shall be made to nominal size plus zero, minus 0·125 mm measured at 27°C.

The spindle diameter should not be less than that listed in Table 1.

2.4 *Length of Machine Spindle Thread* — If the wheels are mounted by means of a central spindle nut and flanges following two conditions shall be maintained:

a) Spindles shall be of sufficient length to allow all the threads of the nuts to engage the spindle; and

b) The threaded portion shall extend from the spindle end to insist the outer flange, but not more than half way within the arbor hole of the minimum width of wheel for which the machine is designed (*see* Fig. 1).

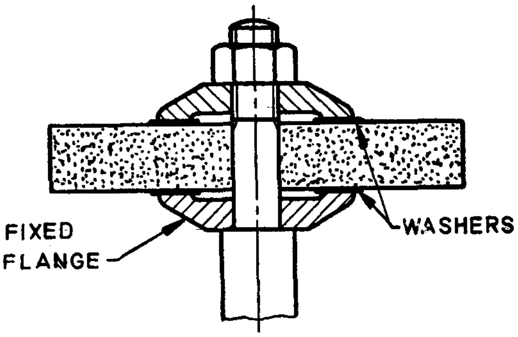


FIG. 1 LENGTH OF MACHINE SPINDLE THREAD

If threaded hole wheels are of cone or plug shape with blind holes, the length of the spindle and the depth of the hole shall be such that the end of the spindle shall not touch the bottom of the wheel hole.

2.5 *Direction of Machine Spindle Thread*

2.5.1 *Machines using plain hole wheels* — If wheels or flanges are secured by means of a central spindle nut, the direction of the thread shall be in such relation to the direction of rotation that the nut will tend to tighten as the spindle revolves. The following rule will assist in determining the proper relationship.

'To remove the nut, it must be turned in the direction that the spindle revolves when the wheel is in operation'.

Exception

On grinding machines, where threads do not conform to the above requirement, a means shall be provided to prevent the wheel or flanges from working loose as the spindle revolves.

On machines with spindle reversal capability and machines where flanges are interchanged from one end of the spindle to the other means must be provided to prevent the wheel(s) and flanges from loosening as the spindle revolves.

When re-assembling double ended machines which have a right hand thread on one end and a left hand thread on the other, care must be used to replace the spindle properly with respect to the direction of the threads.

2.5.2 *Machines using threaded hole wheels* — The direction of the thread shall be such that, to remove the wheel, it must be turned in the same direction in which it rotates when in use.

2.6 *Flanges* — Grinding machines shall be equipped with flanges in accordance with the requirements given in IS : 1991 (Part 5)-1987 'Safety requirements for the use, care and protection of abrasive grinding wheels : Part 5 Flanges'.

Proper selection, use and maintenance of flanges are all essential factors in the safe use of abrasive wheels.

Flange design must be such that flange distortion will not occur under all operating conditions. If distortion occurs, even flange bearing surfaces must be maintained. A failure to maintain even flange bearing surfaces will result in a dangerous operating condition.

2.7 *Wheel Speed Control* — Wheel speed limiting devices shall not be altered and shall be properly maintained [*See* IS : 1991 (Part 9)-1987 'Safety requirements for the use, care and protection of abrasive grinding wheels: Part 9 General operating rules'].

Mounting a larger diameter wheel than the grinding machine is designed may result in the abrasive wheel being operated at surface speed greater than the maximum operating speed specified by the wheel manufacturer. This is a dangerous operating condition.

2.7.1 *Limiting wheel diameter* — Grinding machine shall be provided with a stop or other means of limiting the diameter of wheel which can be mounted. The hood, if of correct size, is satisfactory for this purpose on single speed machines and if the hood is adjustable and mechanically connected with the speed shifting device, it is also acceptable on variable speed machines.

2.7.1.1 *Single speed machines* — The safety guard is satisfactory as a device limiting the wheel diameter, and hence surface speed of the abrasive wheel on single speed machines.

2.7.1.2 *Variable speed floor stand machines* — On variable speed floor stand machines, the speed shifting device shall be connected to an adjustable guard or another diameter limiting device to prevent the mounting of a wheel which may run at higher than the maximum surface speed established by the wheel manufacturer. All such limiting devices, should they fail, shall not cause the wheel to overspeed.

On variable speed machines, the mechanical speed control device must be maintained in proper working condition. Over-riding these controls is dangerous and could result in over-speeding another or full size wheel after the original wheel stub has been removed.

If the wheel speed device is inadvertently ground while adjusting the wheel speed, care should be exercised so that, when repaired, the device performs as originally provided by the manufacturer.

2.7.1.3 *Other variable speed machines* — On other machines which use step pulleys or other wheel speed altering devices, the user shall establish procedures to ensure that the maximum surface speed of the abrasive wheel, established by the wheel manufacturer, *shall* not be exceeded.

2.7.1.4 *Permanent speed marking* — The spindle RPM of single speed grinders shall be permanently marked on the machines and shall be readily visible to the operator(s). On variable speed machines, the range of spindle RPM's shall be permanently marked on the machine and shall be readily visible to the operator(s).

2.8 *Work Rests* — Off hand grinders shall be equipped with a work rest or other device which shall prevent the work-piece from jamming between the abrasive wheel and wheel guard.

Work rests shall be used in accordance with IS : 1991 (Part 9)-1987.

Care should be exercised with variable speed grinders, where the work rest is part of the variable speed control linkage, that a *U* is not ground in the work rest thus creating the possibility that the recommended maximum operating speed of the abrasive wheel is exceeded.

2.9 *Portable Grinding Machines Spindle and Flange Design for Threaded Hole Wheels* — Machine on which threaded hole wheels are mounted shall be provided with spindles which are so threaded as to allow the wheel to be screwed firmly and flat against the back flange [*see* Fig. 2 and 3].

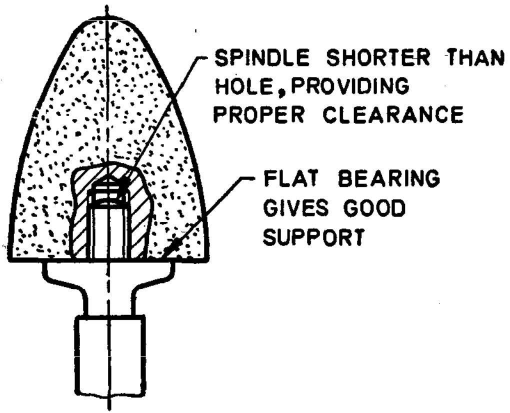

SPINDLE SHORTER THAN HOLE, PROVIDING PROPER CLEARANCE
FLAT BEARING GIVES GOOD SUPPORT

FIG. 2 CORRECT METHOD OF MOUNTING OF THREADED-HOLE WHEEL

2.9.1 *Spindle design* — The direction of the thread shall be such that, to remove the wheel, it must be turned in the same direction in which the wheel rotates when in use.

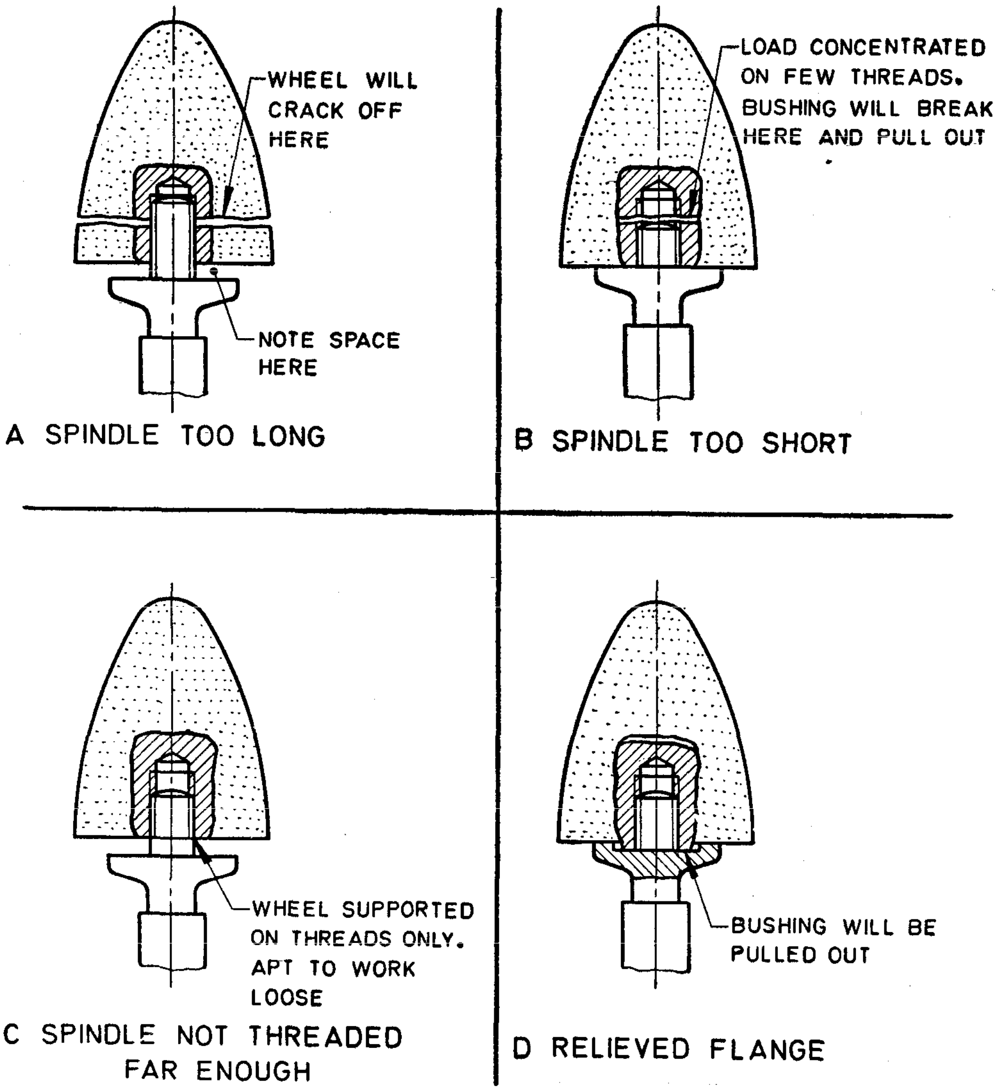
If threaded hole wheels are of cone or plug shape with blind holes, the length of the spindle and the depth of the hole shall be such that the end of the spindle shall not touch the bottom of the wheel hole.

2.9.2 *Flange design* — The back flange shall be flat, unrelieved, securely fastended and square to the spindle axis. The back flange shall be of sufficient diameter to ensure proper support of the wheel.

A relieved back flange shall not be used.

If a relieved back flange is used, it will cause the bushing to be pulled out of the wheel as shown in Fig. 4.

The back flange should be flat and heavy enough to prevent distortion.


WHEEL WILL CRACK OFF HERE
NOTE SPACE HERE
LOAD CONCENTRATED ON FEW THREADS. BUSHING WILL BREAK HERE AND PULL OUT
WHEEL SUPPORTED ON THREADS ONLY. APT TO WORK LOOSE
BUSHING WILL BE PULLED OUT

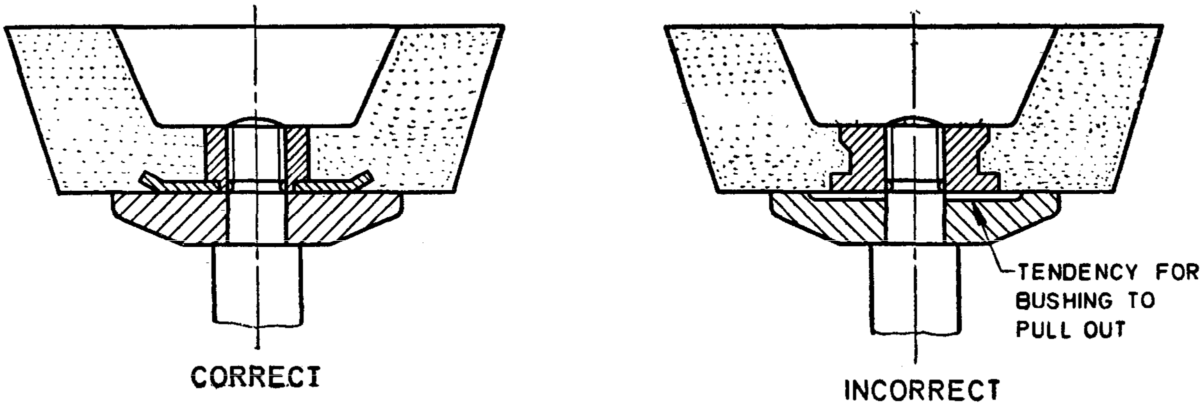
A SPINDLE TOO LONG

B SPINDLE TOO SHORT

C SPINDLE NOT THREADED FAR ENOUGH

D RELIEVED FLANGE

FIG. 3 INCORRECT METHODS OF MOUNTING OF THREADED-HOLE WHEEL



CORRECT

Flat flange, no relief — provides proper support for steel bushing and wheel.

INCORRECT

Relieved flange does not provide proper support.

FIG. 4 UNRELIEVED AND RELIEVED FLANGES

2.10 *Mount Design for Abrasive Discs (Inserted Nut, Inserted Washer and Projecting Stud Type)* — Machines on which inserted nut wheels are mounted shall be provided with a machine face plate (steel disc wheel) having a diameter at least equal to the nominal diameter of the abrasive wheel with a minus tolerance not greater than 25 mm and of sufficient thickness to provide necessary support. Minimum machine face plate (steel disc wheel) thickness for disc grinders shall be as shown in Table 2.

2.10.1 The threaded holes in the inserted nuts in the abrasive wheels shall be accurately located to match the standards set forth for machine face plates.

2.10.2 The screw holes in the machine face plate (steel disc wheels) shall be large enough such that the screws will not bind.

Dimensions *X* (Fig. 5) shall be uniform for all holes so that screws may be used interchangeably.

Figures 6 to 8 will serve to clarify the difference which exists between the three types of mountings for abrasive discs, that is, the inserted nut type, the inserted washer type and the projecting stud type.

The machine face plate (steel disc wheel) must be maintained true, flat, and clean. When re-grinding the face plate, caution should be taken to ensure that the *X* dimension (Fig. 5) is not ground so small that when mounting, the screws could touch the bottom of the hole. If this condition occurs, the inserted nuts may be pulled out.

TABLE 2 MINIMUM THICKNESS OF MACHINE FACE PLATE FOR MOUNTING ABRASIVE DISCS

(*Clauses* 2.10 *and* 2.11)

All dimensions in millimetres.

Diameter	Minimum Thickness
200 to 350 inclusive	13
Above 350 to 450 inclusive	16
Above 450 to 650 inclusive	20
Above 650 to 900 inclusive	22
Above 900 to 1 000 inclusive	25
Above 1 000 to 1 800 inclusive	28

Note — These thicknesses are not adequate for heavy duty disc grinders. For this class of service, thicknesses must be specified by the manufacturer.

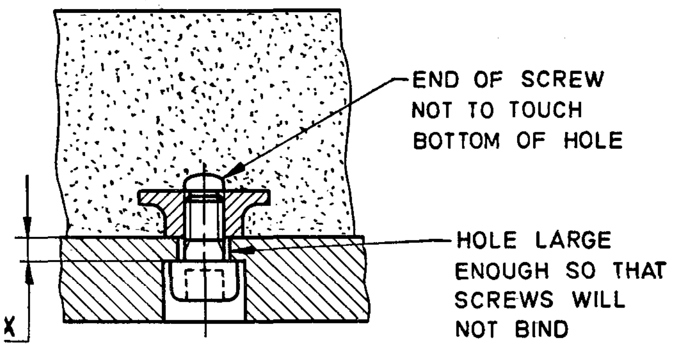

END OF SCREW NOT TO TOUCH BOTTOM OF HOLE
HOLE LARGE ENOUGH SO THAT SCREWS WILL NOT BIND
X

FIG. 5 INSERTED NUT MOUNTING

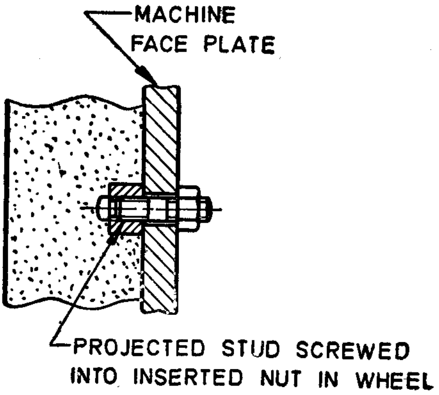


FIG. 6 METHOD OF MOUNTING

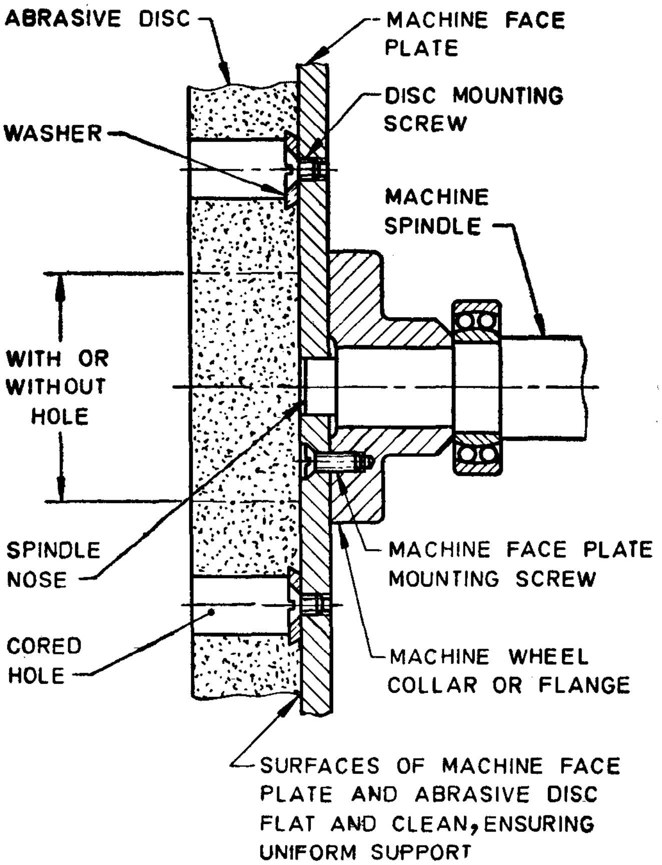

ABRASIVE DISC
MACHINE FACE PLATE
DISC MOUNTING SCREW
WASHER
MACHINE SPINDLE
WITH OR WITHOUT HOLE
SPINDLE NOSE
CORED HOLE
MACHINE FACE PLATE MOUNTING SCREW
MACHINE WHEEL COLLAR OR FLANGE
SURFACES OF MACHINE FACE PLATE AND ABRASIVE DISC FLAT AND CLEAN, ENSURING UNIFORM SUPPORT

FIG. 7 INSERTED WASHER TYPE ABRASIVE DISCS (Washer Embedded In Abrasive Discs)

2.10.3 Screws shall be of sufficient length to properly engage the threads in the inserted nuts, yet not so long that there will be any possibility of the ends touching bottom.

2.10.4 Machine face plates (steel disc wheels) shall be flat, concentric and at a 90° angle to the machine spindle when mounted.

2.11 *Mount Design for Plate Mounted Type Wheels* — If the plate attached to the wheel is as thick or thicker than shown in Table 2, there are no special requirements as to the diameter and thickness of the machine face plate (steel disc wheel) on the machine.

If the plate attached to the wheel is thinner than shown in Table 2, the machine shall be equipped with a machine face plate (steel disc wheel) of sufficient diameter and thickness to provide adequate additional support. Minimum specification are given in Table 3 for disc grinders.

A typical method of mounting a plate mounted type wheel is shown in Fig. 9. Note the additional reinforcement given the abrasive disc and the mounting plate by the machine face plate (steel disc wheel).

Even when plate mounted wheels are used, the machine face plate (steel disc wheel) should be the full diameter of the weel, where possible. The original thickness of the machine face plate should be thicker than the minimum in Table 3 to allow for re-machining to correct for wear.

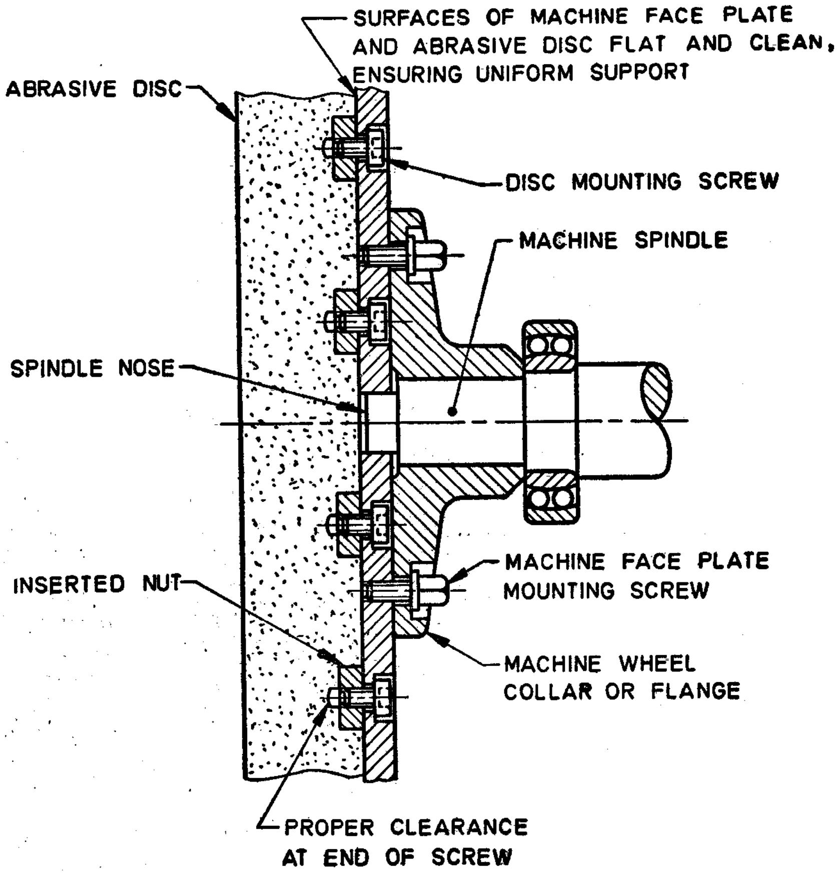

SURFACES OF MACHINE FACE PLATE AND ABRASIVE DISC FLAT AND CLEAN, ENSURING UNIFORM SUPPORT
ABRASIVE DISC
DISC MOUNTING SCREW
MACHINE SPINDLE
SPINDLE NOSE
MACHINE FACE PLATE MOUNTING SCREW
INSERTED NUT
MACHINE WHEEL COLLAR OR FLANGE
PROPER CLEARANCE AT END OF SCREW

FIG. 8 INSERTED-NUT TYPE ABRASIVE DISC

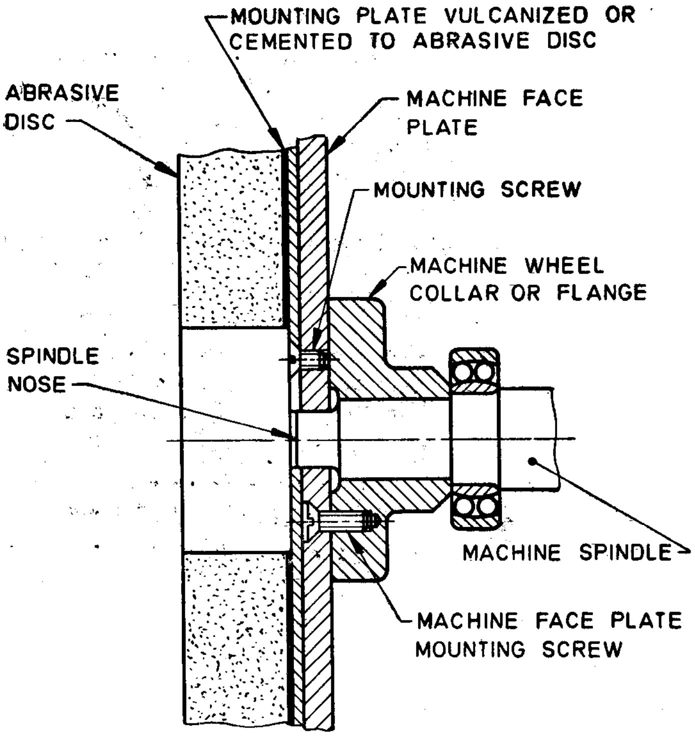
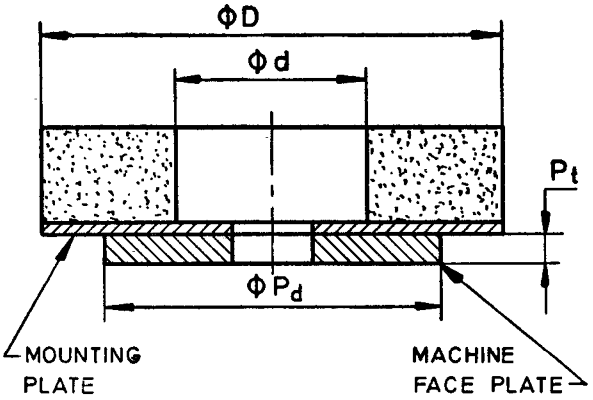

MOUNTING PLATE VULCANIZED OR CEMENTED TO ABRASIVE DISC
ABRASIVE DISC
MACHINE FACE PLATE
MOUNTING SCREW
MACHINE WHEEL COLLAR OR FLANGE
SPINDLE NOSE
MACHINE SPINDLE
MACHINE FACE PLATE MOUNTING SCREW

FIG. 9 PLATE MOUNTED WHEEL

TABLE 3 MINIMUM THICKNESS OF MACHINE FACE PLATES FOR PLATE MOUNTED DISCS AND CYLINDERS HAVING THIN MOUNTING PLATES

(*Clause* 2.11 and *Fig.* 9)



All dimensions in millimetres.

Abrasive Disc Diameter D	Minimum Thickness P_t
300 and smaller	9
350 to 400 inclusive	13
425 to 450 inclusive	16
475 to 650 inclusive	20
675 to 900 inclusive	22

Note 1 — These thicknesses are not adequate for heavy duty disc grinders. For this class of service, thickness must be specified by the manufacturer.

Note 2 — P_d shall never be less than $\frac{D+d}{2}$, nor shall the difference between D and P_d exceed 50 mm. It is recommended that P_d shall equal D wherever practicable.

EXPLANATORY NOTE

The safe operation of abrasive wheels requires the understanding and cooperation of many diverse groups and of all individuals concerned with their use or operation. This has been the basic viewpoint in establishing these safety requirements for the guidance of manufacturers, users and others involved in handling these products.

A thorough knowledge of nature and characteristics of abrasive wheels, the grinding machines on which they are used and the safety and protection devices which can and shall be used to limit, if not eliminate, injury or damage in case of accidental wheel breakage, is necessary for proper understanding of these safety requirements. These safety requirements may be used as a guide and not as an alternative to constant educational programmes at all levels which are the best insurance against those unforeseen conditions or circumstances which result in an industrial accident.

The mandatory requirements are printed in normal (10 points) type and the explanatory information in smaller (8 point) type. This is intended to facilitate a condensed document of mandatory requirements together with supporting tables and a figure. The explanatory information gives the basic reasons for the rules to encourage their implementation in practice. However, it may not be termed as part of the standard. The explanatory material has been included to encourage compliance and it is given only where it amplifies or clarifies a requirement.

Operating rules are not included in these safety requirements unless they are of such a nature as to be important safety requirements equal in importance to other requirements included in this standard. This standard was first issued in 1962 and its first revision was taken up in 1973, based on ANSI B 7.1-1970.

In order to review the individual section at any time and also for technical and drafting reasons alike, this standard has been split up in the following ten parts:

Part 1	Scope and definitions
Part 2	Handling and storage
Part 3	General machine requirements
Part 4	Safety guards
Part 5	Flanges
Part 6	Inspection and mounting
Part 7	Standard speeds
Part 8	Special speeds
Part 9	General operating rules
Part 10	Mounted wheels

While splitting, this part (Part 3) of the standard has also been revised and the details have been made more explicit. More data has also been included.

While revising this standard, assistance has also been taken from the following publications:

'European safety requirement for the use, care and protection of abrasive wheels', issued by the Federation of European Producers of Abrasive Products (FEPA).

ANSI B 7.1-1978 'Safety requirement for the use, care and protection of abrasive wheels', issued by the American National Standards Institute, USA.

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